

# A New Species of Corydoradinae Catfish (Ostariophysi: Siluriformes: Callichthyidae) from Rio Solimões Basin, Brazil

Marcelo R. Britto<sup>1</sup>, Wolmar B. Wosiacki<sup>2</sup>, and Luciano F. A. Montag<sup>3</sup>

**A new species of *Corydoras* from the Rio Urucu basin, a right-bank tributary of the Rio Solimões is described. The new species shares a distinctive pigmentation pattern with *Corydoras arcuatus*, *C. gracilis*, and *C. narcissus*, composed of a uniform light ground color on the body, and a dark, arched stripe from tip of snout to caudal-fin base along the upper portion of the dorsolateral body plates. The new species is readily distinguished from these congeners by the absence of a continuation of the arc-like stripe onto the snout. It also differs from *Corydoras gracilis* and *C. narcissus* by the posterior part of the arc-stripe reaching the base of the lower caudal-fin rays, and from *C. arcuatus* and *C. narcissus* by the distinctly rounded profile of the snout in lateral view, a greater preadipose distance, and the position of the posterior limit of the cleithrum. Despite the general resemblance, investigation about the position of the new species in light of previous phylogenetic hypotheses concerning this subfamily indicates that the arc-striped coloration pattern was independently acquired.**

**Uma nova espécie de *Corydoras* da bacia do Rio Urucu, um afluente da margem direita do Rio Solimões, é descrita. A nova espécie compartilha um padrão de pigmentação com *Corydoras arcuatus*, *C. gracilis*, e *C. narcissus*, composto de colorido claro e uma faixa escura em arco da extremidade do focinho a base da nadadeira caudal através da porção superior das placas dorsolaterais do corpo. A nova espécie é prontamente distinta destas congêneres pela ausência de continuação da faixa se estendendo até o focinho. Também se distingue de *Corydoras gracilis* e *C. narcissus* pela extremidade posterior da faixa em arco alcançar a base dos raios inferiores da nadadeira caudal, e de *C. arcuatus* e *C. narcissus* pelo perfil do focinho distintamente arredondado em vista lateral, pela maior distância pré-adiposa, e pela posição do limite posterior do cleitro. Apesar da semelhança, investigações sobre a posição da nova espécie a luz de hipóteses filogenéticas prévias sobre a subfamília, indicam que o padrão de colorido com uma faixa em arco foi adquirido independentemente.**

THE genus *Corydoras* is the most speciose genus of catfishes, and currently includes more than 150 species (Reis, 2003; Ferraris, 2007). The species of *Corydoras* are widely distributed throughout cis-Andean South America in small streams, along river margins, and in pools.

Sixty-five species of *Corydoras* are known at present from the rivers of the western Amazon upriver of the confluence of the Rio Solimões and Rio Negro (Reis, 2003; Ferraris, 2007), and many other species remain undescribed (Fuller and Evers, 2005). Recently during ichthyological surveys in the Rio Urucu system, a right-bank tributary of Rio Solimões, specimens of a species of *Corydoras* were collected that appeared to be similar to several species that have an arc-like stripe (i.e., *C. arcuatus*, *C. narcissus*, and *C. gracilis*). Examination of the material revealed that this is a new species of *Corydoras*, which is described herein.

## MATERIALS AND METHODS

Morphometric and meristic data were taken following Reis (1997). Length of the ossified portion of the pectoral spine was measured from the point of articulation of the spine to the pectoral girdle to the distal tip of the spine. Measurements were taken with calipers to 0.1 mm. Teeth and vertebral counts were taken from cleared-and-stained (CS) specimens prepared according to Taylor and Van Dyke (1985). Vertebral counts include only free centra, with the compound caudal centra (preural 1 + ural 1) counted as a single element. Lateral plate counts include all dorsolateral

and ventrolateral plates, except for the small, irregular plates on the caudal peduncle. In the description, numbers in parentheses following each count represent total of specimens with that value. Numbers with an asterisk represent counts from the holotype. Nomenclature of latero-sensory canals follows Schaefer and Aquino (2000), and that of preopercular pores follows Schaefer (1988). Osteological terminology follows Reis (1998), except that parieto-supra-occipital is used instead of supraoccipital (Arratia and Gayet, 1995), compound pterotic instead of pterotic-supracleithrum (Aquino and Schaefer, 2002), and scapulocoracoid instead of coracoid (Lundberg, 1970). Homology of barbels follows Britto and Lima (2003). Phylogenetic analyses were performed using the character-data matrix published by Britto (2003), including outgroup data provided in that study, with the addition of the new species. The analysis was performed using Hennig86 software (Farris, 1988) via the heuristic algorithm “mhennig\*” associated with the command “bb\*” (“branch-breaker”). Attributes of connectivity and ambiguity among character-states were treated in the same way as in Britto (2003). Institutional abbreviations are as listed at <http://asih.org/codons.pdf>, with the addition of IAvH, Instituto de Investigación de Recursos Biológicos Alexander von Humboldt, Colombia.

## *Corydoras urucu*, new species

Figure 1, Table 1

**Holotype.**—MPEG 14924, 27.5 mm SL, Brazil, Amazonas State, Coari, Igarapé da Onça, Rio Urucu basin, tributary of

<sup>1</sup>Museu Nacional/UFRJ, Setor de Ictiologia, Departamento de Vertebrados, Quinta da Boa Vista s/n, São Cristóvão, 20940-040 Rio de Janeiro, RJ, Brazil; E-mail: mrbritto2002@yahoo.com.br. Send reprint requests to this address.

<sup>2</sup>Museu Paraense Emílio Goeldi, Av. Magalhães Barata 376, Cx. Postal 399, 66040-170 Belém, PA, Brazil; E-mail: wolmar@museu-goeldi.br.

<sup>3</sup>Universidade Federal do Pará, Laboratório de Vertebrados-Ictiologia, Instituto de Ciências Biológicas, Rua Augusto Corrêa 01, Guamá, Cx. Postal 479, 66075-110 Belém, PA, Brazil; E-mail: lfamontag@gmail.com.

Submitted: 4 December 2008. Accepted: 18 May 2009. Associate Editor: C. J. Ferraris.

© 2009 by the American Society of Ichthyologists and Herpetologists DOI: 10.1643/CI-08-228



**Fig. 1.** *Corydoras urucu*, MPEG 14924, holotype, 27.5 mm SL, Igarapé da Onça, tributary of Rio Urucu, tributary of Lago Coari, Coari, Amazonas, Brazil.

Lago Coari, Rio Solimões system, 4°52'9.12"S, 65°18'3.6"W, 19 November 2006, W. B. Wosiacki, L. F. A. Montag, and M. B. Mendonça.

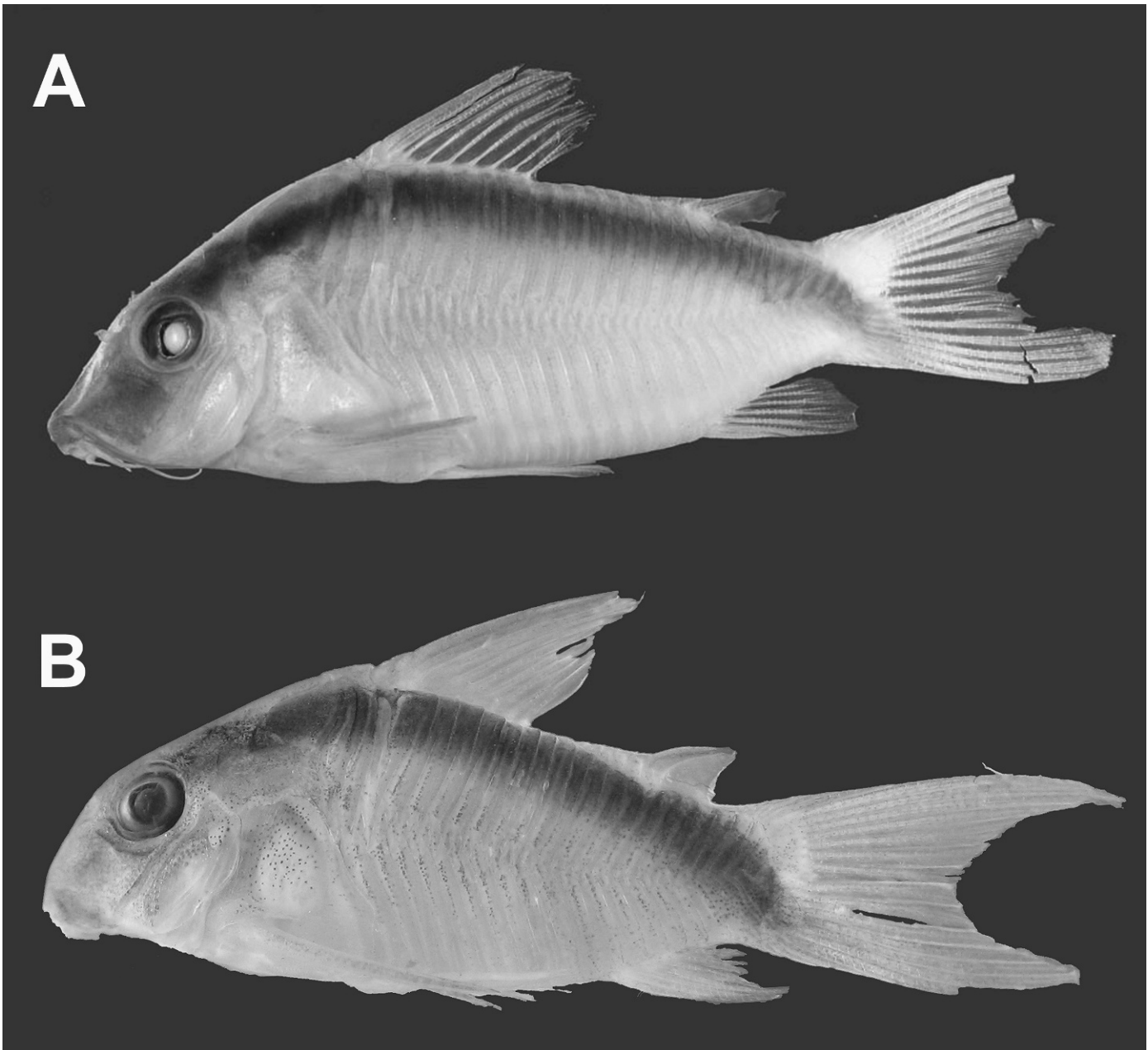
**Paratypes.**—MPEG 12239, 6, 25.2–27.4 mm SL; MNRJ 32446, 4, 25.9–27.3 mm SL; all collected with holotype; MPEG 11252, 4, 22.5–25.8 mm SL (2 CS), same locality and collectors as the holotype, 22 August 2006; MPEG 15102, 8, 20.0–23.0 mm SL, same locality as the holotype, 26 July 2008, W. B. Wosiacki, L. F. A. Montag, and C. S. Ramos.

**Diagnosis.**—*Corydoras urucu* is distinguished from all other species of *Corydoras*, except for *C. arcuatus*, *C. narcissus*, and *C. gracilis*, by the presence of a long, arched, dark stripe, running parallel to the dorsal profile and extending at least from the anterior margin of the first dorsolateral body plate to the caudal peduncle. *Corydoras urucu* differs from *C. arcuatus*, *C. gracilis*, and *C. narcissus* in having the arc-like stripe terminating posterior to the orbit (vs. extending onto snout; Fig. 2). *Corydoras urucu* further differs from *C. arcuatus* by having fewer free vertebrae (21 vs. 27); the lateral profile of the snout distinctly rounded (vs. nearly straight); a greater preadipose distance (84.0–86.7% SL, vs. 82.9–83.8% SL); and the posterior limit of the cleithrum at a vertical through the dorsal-fin spinelet (vs. between the third and fourth dorsal-fin rays). *Corydoras urucu* further differs from *C. gracilis* by having fewer free vertebrae (21 vs. 27); the arched stripe extending posteriorly to the base of the lower caudal-fin rays (vs. reaching the base of the upper caudal-fin rays); and the second infraorbital contacting only the sphenotic (vs. contacting both the sphenotic and compound pterotic). *Corydoras urucu* further differs from *C. narcissus* in having the arched stripe extending posteriorly across the lower caudal-fin rays (vs. extending over the lower caudal-fin rays); the lateral profile of the snout distinctly rounded (vs. nearly straight); and by minute and weak pectoral-spine serrations (Fig. 3; vs. large and strong serrations; Nijssen and Isbrücker, 1980:fig. 4c).

**Description.**—Morphometric data presented in Table 1. Head compressed with convex dorsal profile (Fig. 1); roughly triangular in dorsal view. Snout rounded. Head profile convex from upper lip to tip of parieto-supraoccipital expansion. Dorsal profile of body slightly convex from tip of parieto-supraoccipital expansion to base of last dorsal-fin

**Table 1.** Morphometric Data of Holotype and Paratypes of *Corydoras urucu* ( $n = 22$ , other than  $n = 16$  for maximum cleithral width).

	Holotype	Paratypes	
		Mean	Range
Standard length (mm)	27.5	24.2	20.0–27.4
<b>Percentage of standard length</b>			
Depth of body	35.3	33.9	31.1–37.1
Predorsal distance	50.0	50.3	46.5–53.7
Prepelvic distance	46.1	47.2	44.7–51.4
Preal anal distance	82.0	79.8	75.2–82.9
Preadipose distance	84.3	82.8	78.0–86.7
Length of dorsal spine	30.2	26.8	23.4–29.9
Length of pectoral spine	29.7	28.3	23.2–32.1
Length of adipose-fin spine	9.0	8.7	6.7–10.8
Depth of caudal peduncle	15.9	15.1	13.5–16.7
Dorsal to adipose distance	21.6	19.2	15.6–23.0
Length of dorsal-fin base	19.7	19.1	16.7–25.0
Maximum cleithral width	27.6	19.4	17.3–21.0
Head length	44.5	44.0	42.6–46.4
Length of maxillary barbel	18.0	13.3	8.9–17.2
<b>Percentage of head length</b>			
Head depth	79.2	75.7	71.3–80.9
Least interorbital distance	29.4	30.9	28.9–33.3
Horizontal orbit diameter	24.3	26.0	22.8–29.0
Snout length	35.9	33.8	30.1–37.5
Least internarial distance	17.8	15.6	13.5–20.7



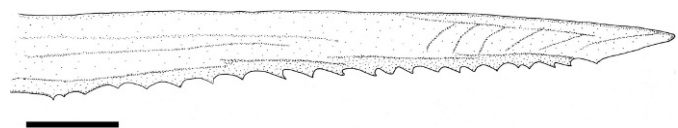
**Fig. 2.** *Corydoras arcuatus*. (A) BMNH 1939.3.3:1, holotype, 44.6 mm SL, aquarium specimen; (B) MZUSP 42512, 25.4 mm SL, Rio Tabatinga, near Brazil–Peru border, Leticia, Amazonas, Brazil.

ray. Postdorsal-fin body profile slightly concave to base of adipose-fin spine; straight to slightly concave from that point to caudal-fin base. Ventral profile of body straight from isthmus to pelvic-fin origin, slightly convex from that point to anal-fin origin. Profile slightly concave from first anal-fin ray to caudal-fin base. Body roughly triangular in cross section at pectoral girdle, gradually becoming more compressed toward caudal fin.

Eye round, located dorso-laterally on head; orbit delimited dorsally by frontal and sphenotic, ventrally by infra-orbitals. Anterior and posterior nares proximal and only separated by flap of skin. Anterior naris tubular. Posterior naris close to anterodorsal margin of orbit, separated from orbit by distance slightly smaller than naris diameter. Mouth small, subterminal, width nearly equal to bony orbit diameter. Maxillary barbel not reaching anteroventral limit of gill opening. Length of maxillary barbel nearly equal to

that of outer mental barbel. Inner mental barbel fleshy. Small rounded papillae covering entire surface of all barbels, upper and lower lips, and isthmus. Gill membranes united to isthmus. Four branchiostegal rays covered by thin layer of skin; two distal branchiostegal rays united at their tips by branchiostegal cartilage. Teeth on upper pharyngeal tooth plate 46(1), and on fifth ceratobranchial 45(1).

Posterior area of mesethmoid, frontal, sphenotic, compound pterotic, and parieto-supraoccipital visible external-



**Fig. 3.** Right pectoral spine of *Corydoras urucu*, MNRJ 32446, 26.7 mm SL, odontodes and head of spine not depicted. Scale bar 1.0 mm.

ly, all covered by thin layer of skin and bearing minute scattered odontodes. Frontal fontanel elongate, ellipsoid, covered by thin layer of skin; posterior portion extending into parieto-supraoccipital. Nasal slender, curved laterally, mesial border contacting frontal. Frontal roughly rectangular; anterior expansion in contact with nasal bone, posterior portion contacting sphenotic and parieto-supraoccipital. Sphenotic trapezoid in shape, contacting parieto-supraoccipital dorsally, compound pterotic posteriorly, second infraorbital ventrally. Compound pterotic roughly pipe-shaped, with posterior expansion contacting first lateral-line ossicle. Ventral margin of compound pterotic contacting opercle and cleithrum. Parieto-supraoccipital quadrangular with posterior expansion notched at its tip, sutured with nuchal plate.

Two infraorbital bones, externally visible, covered by thin layer of skin. First infraorbital with anterior expansion. Second infraorbital bone contacting only sphenotic posteriorly. Opercle exposed, compact in shape, with smooth free border. Preopercle externally visible, slender, and covered by thin layer of skin.

Trunk lateral line with three laterosensory canals; two anteriormost canals reduced to small ossicles. Last lateral-line canal encased in second dorsolateral body plate. Lateral-line canal entering neurocranium through compound pterotic, splitting into three branches before entering sphenotic: pterotic and preoperculo-mandibular, each with single pore. Sensory canal continuing through compound pterotic, entering sphenotic as temporal canal, which splits into two branches: one branch giving rise to infraorbital canal, other branch entering frontal through supraorbital canal. Supraorbital canal not branched, running through nasal bone. Epiphyseal pore opening at supraorbital main canal. Nasal canal with single opening at each end. Infraorbital canal running through entire second infraorbital, extending to infraorbital 1 and opening into three pores. Preoperculo-mandibular branch giving rise to preoperculo-mandibular canal, which runs through entire preopercle with three openings, leading to pores 3, 4, and 5, respectively.

Body plates with minute odontodes restricted to posterior margins. Nuchal plate exposed. Posterior extremity of cleithrum along vertical through dorsal-fin spinelet. Cleithrum and mesial process of scapulocoracoid exposed. Body plates not touching counterparts ventrally, leaving narrow naked area. Dorsolateral body plates 23(2), 24\*(21); ventrolateral body plates 21\*(20), 22(1); dorsolateral body plates along dorsal-fin base 6(6), 7\*(17); dorsolateral body plates from adipose fin to caudal-fin base 8\*(20), 9(3); preadipose platelets 3(1), 4(3), 5\*(16), 6(3). Precaudal vertebrae 6, and caudal vertebrae 15 in all cleared-and-stained specimens. Six pairs of ribs, first pair conspicuously larger than others.

Dorsal fin roughly triangular, located just posterior to second dorsolateral body plate. Dorsal spine shorter than first branched ray. Anterior border of dorsal spine smooth; posterior border with 3–18 minute serrations. Dorsal-fin rays I,8 in all specimens. Adipose fin roughly triangular, separated from base of last dorsal-fin ray by 7–8\* dorsolateral body plates. Anal fin roughly triangular, located just posterior to 13<sup>th</sup> ventrolateral body plates, and at vertical through anterior margin of adipose-fin spine. Anal-fin rays ii,5,i in all specimens. Pectoral fin triangular, its origin located just posterior to gill opening. Ossified portion of pectoral spine shorter than first branched ray. Distal tip of

spine with minute, segmented, unossified portion. Pectoral spine with 16–25 small serrations along entire posterior border. Pectoral serrations more developed than those of dorsal spine. Pectoral-fin rays I,8\*(20), or I,7(3). Pelvic fin ellipsoid, located just below first ventrolateral body plate, and at vertical through first branched dorsal-fin ray. Pelvic-fin rays i,5 in all specimens. Caudal fin bilobed; upper lobe slightly longer. Principal caudal-fin rays i,6/6,i. Upper and lower procurent caudal-fin rays both 5. All fins with minute odontodes scattered over all rays.

**Color in alcohol.**—Ground coloration of head yellowish light brown. Scattered chromatophores over interorbital and supraoccipital areas, but more concentrated over parieto-supraoccipital. Diffuse narrow stripe along mid-sagittal line over posterior expansion of parieto-supraoccipital. Scattered chromatophores over snout and outer mental barbel. Remaining barbels yellowish light brown. Opercle and preopercle with several, small, scattered chromatophores over their surfaces. Chromatophores more concentrated over anterior half of both bones.

Ground color of trunk light brown. Large, yellowish-white area on midregion of cleithrum surrounded by several scattered chromatophores more concentrated on posterior portion of cleithrum. Long, black, arched stripe from anterodorsal margin of first dorsolateral body plate throughout upper half of dorsal plates until base of lower caudal fin. Chromatophores concentrated as small irregular blotches at lower and upper portions of dorsal and ventral plates, respectively. All fins hyaline. First dorsal-fin ray and base of caudal-fin rays with minute, scattered chromatophores. Scattered chromatophores over preadipose platelets and extending to adipose spine.

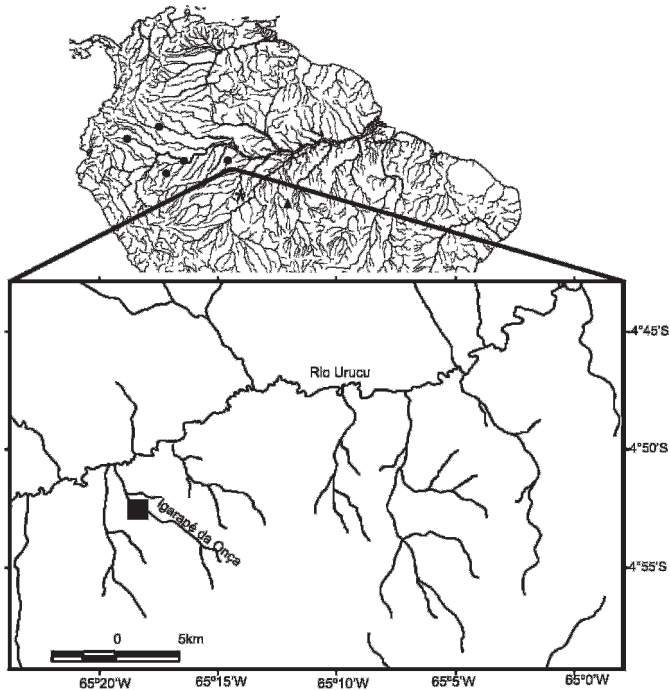
**Habitat and ecological notes.**—All specimens of *Corydoras urucu* were collected along semilentic stretches of the shore of the Igarapé da Onça. The Igarapé da Onça is a moderately large stream, about 15 m wide, with sand, clay, and leaves on the bottom, in addition to emerged vegetation. It has an average depth of 1 m during the dry season, and 4 m in the rainy season.

**Distribution.**—*Corydoras urucu* is only known from its type locality (Fig. 4).

**Etymology.**—The name “urucu” is taken from the type locality, the Rio Urucu basin. Originally, the word comes from the Tupi (“*uru-ku*”) for red, derived from the color of the fruit of the “*urucuzeiro*” (*Bixa orellana* L.), low tree of the family Bixaceae, native from tropical America. Treated as a noun.

## DISCUSSION

*Corydoras urucu* was initially grouped with the arc-striped species of *Corydoras*, viz. *C. arcuatus*, *C. narcissus*, and *C. gracilis*, whose distributions fall within the limits of the Western Amazonian area of endemism identified by Britto et al. (2007). In this area, *Corydoras arcuatus* shows the largest range of distribution, with records from several tributary river basins of the Rio Solimões system (e.g., Río Caquetá, Río Napo, Río Purus, Río Tefé, Río Ucayali, Río Yavari; Nijssen and Isbrücker, 1980, 1986; Castro, 1987; Britto, 2007; Fig. 4, circles). Moreover, populations of *Corydoras arcuatus* occur syntopically with *C. narcissus*, and there are



**Fig. 4.** Map of northern South America, showing the distribution of *Corydoras urucu* (square in inset), *C. arcuatus* (circle), *C. gracilis* (triangle), and *C. narcissus* (asterisk). Inset: detail of Rio Urucu basin showing the type locality of *Corydoras urucu*.

records of some representatives of *C. arcuatus* having been collected with the type of the latter species (Nijssen and Isbrücker, 1980:498–499). Although the type-locality of *Corydoras urucu* is included in the distributional range of *C. arcuatus*, there are no previous records for arc-striped *Corydoras* specimens either in scientific collections or even in the aquarium literature from Rio Urucu and Lago Coari.

Despite *Corydoras urucu* having been promptly distinguished from *C. arcuatus* as shown in the diagnosis and discussion below, there is some resemblance between the new taxon and juveniles of the latter species at first inspection. Small specimens of *Corydoras arcuatus* within the size range of *C. urucu* (20.0–27.0 mm) superficially resemble adults of the latter, but differ nonetheless in the characters listed in the diagnosis. Furthermore, juveniles of *C. arcuatus* that are shorter than this size range do not show the snout portion of the arc stripe, and the body stripe is broken into several irregular, dark blotches (Fuller, 2001:38–39). Also, specimens of *Corydoras arcuatus* that are up to this size range show dorsolateral body plates not touching their counterparts, leaving a median groove between the last dorsal-fin ray and the first preadipose platelet (vs. dorsolateral body plates touching their counterparts in *C. urucu*). This kind of difference was already reported between other species of *Corydoras* (Britto and Lima, 2003). Moreover, *Corydoras arcuatus* reaches a body size greater than *C. urucu*.

*Corydoras urucu* was recovered in the phylogenetic analysis in a clade distinct from the other included arc-striped species (i.e., *C. arcuatus* and *C. gracilis*; *C. narcissus* is only known from its holotype, ZMA 115.178), which further supports the observation in Britto (2003) that this distinctive color pattern arose more than once within *Corydoras*. Nijssen and Isbrücker (1980) already suggested convergence of an arc-striped color pattern in the original description of *Corydoras narcissus*. Both authors speculated that *Corydoras*

*narcissus* could be closer to *C. acutus* than to *C. arcuatus*. Besides, the arc-stripe-bearing species also display differences concerning extension of the stripe, as cited in the diagnosis.

As reported in the diagnosis, *Corydoras urucu* exhibits a set of characters that readily distinguishes it from *C. arcuatus*, *C. narcissus*, and *C. gracilis*. In addition, there are several osteological character-states, shared in different levels with other species of *Corydoras*, which recover *C. urucu* apart from other arc-striped *Corydoras*. This evidence refers to structural complexes examined in Britto (2003) like neurocranium (characters 1, 5, 7, and 12), infraorbitals (characters 17 and 18), gill arches (characters 22, 23, and 28), suspensorium and mandibular arch (characters 33 and 39), axial skeleton (characters 51), anal fin (characters 59), and pelvic girdle (characters 69 and 70). Although not exclusive to *Corydoras urucu*, some of these conditions deserve comments concerning their differences among arc-striped species of *Corydoras*. Among that assemblage of character-states, the short anterior portion of the mesethmoid (character 1) could be related to the rounded snout shape in *C. urucu*. Although *Corydoras arcuatus* and *C. narcissus* are set apart from each other by the length of the snout (Nijssen and Isbrücker, 1980), the feature stated above concerns the shape of the snout, not necessarily its length. Accordingly, *C. arcuatus* shows a short snout but straight in shape (Fig. 2). The slender shape of the complex vertebra in *Corydoras urucu* (character 12; shared with *C. gracilis*) could also be related with some morphometric component, although it was not sensitive to the measurements taken herein.

Although the evidence assigns the non-monophyly of an arc-striped group of *Corydoras*, it is premature to pinpoint the sister-group of *Corydoras urucu*. The inclusion of *Corydoras urucu* in Britto's (2003) data matrix recovered it in a large polytomy, outside of clade VIII in that study (a group composed of *C. arcuatus* and *C. gracilis*, among other species of *Corydoras*). Nevertheless, such evidence contrasts with those hypotheses of sister-group relationships among corydoradine catfishes corroborated by unique acquisitions of character-state conditions of coloration (e.g., *Corydoras hastatus*/*C. pygmaeus*; Schaefer et al., 1989; Britto, 2003; *Corydoras ortegai*/*C. panda*/*C. tukano*/*C. weitzmani*; Britto et al., 2007). The contrasting examples of the occurrence of both well-corroborated monophyletic groups within *Corydoras* sharing a similar color pattern, on one hand, and highly homoplastic color patterns, as the species of *Corydoras* sharing an arc-striped color pattern, serve as a warning about the complexity of the evolution in the genus.

#### MATERIAL EXAMINED

A list of the comparative material is available in Britto and Castro (2002) and Britto (2003). In addition, the following material was studied:

*Corydoras arcuatus*: BMNH 1939.3.3.1 (holotype); FMNH 94678, 21; IAvH-P 3797, 1; IAvH-P 5958, 2; NRM 13396, 4; USNM 317900, 4, 2 CS.

*C. gracilis*: INPA 7759, 5, 2 CS; MPEG 9260, 2; MPEG 9278, 2.  
*C. rabauti*: MPEG 3244, 1.

#### ACKNOWLEDGMENTS

We thank J. Maldonado-Ocampo (IAvH), O. Oyakawa, and F. Lima (MZUSP) for the loan of specimens, and J. Maclaine

(BMNH) for kind reception at that institution. P. Willink (FMNH) kindly provided photographs and radiographs of *Corydoras arcuatus*. W. Wosiacki and L. Montag received financial support from Financiadora de Estudos e Projetos (FINEP), and logistical support from Petrobras (Rede CT-Petro, PT1). The Programa de Pesquisa em Biodiversidade (PPBio) of the Ministério da Ciência e Tecnologia (MCT) Brazilian government and CNPq (PCI fellowships) supported the trip of M. Britto to Belém. M. Mendonça assisted in the ichthyological surveys. Specimens of *Corydoras urucu* were collected under collecting permits IBAMA 10102-1. M. Britto received financial support from CNPq (grants 300189/03-6, 502975/2005-9, and 474788/2006-7) and FAPERJ (grant E-26/170.687/2007). The authors are participants in the All Catfish Species Inventory (NSF 0315963).

#### LITERATURE CITED

- Aquino, A. E., and S. A. Schaefer.** 2002. The temporal region of the cranium of loricioid catfishes (Teleostei: Siluriformes): morphological diversity and phylogenetic significance. *Zoologischer Anzeiger* 241:223–244.
- Arratia, G., and M. Gayet.** 1995. Sensory canals and related bones of tertiary siluriform crania from Bolivia and North America and comparison with recent forms. *Journal of Vertebrate Paleontology* 15:482–505.
- Britto, M. R.** 2003. Phylogeny of the subfamily Corydoradinae Hoedeman, 1952 (Siluriformes: Callichthyidae), with a definition of its genera. *Proceedings of the Academy of Natural Sciences of Philadelphia* 153:119–154.
- Britto, M. R.** 2007. Callichthyidae, p. 75–81. *In: Catálogo das Espécies de Peixes de Água Doce do Brasil*. P. A. Buckup, N. A. Menezes, and M. S. Ghazzi (eds.). Museu Nacional/UFRJ (Série Livros), Rio de Janeiro, Brazil.
- Britto, M. R., and R. M. C. Castro.** 2002. A new corydoradine catfish (Siluriformes: Callichthyidae) from the upper Paraná and São Francisco: the sister-group of *Brochis* and most of *Corydoras* species. *Copeia* 2002:1006–1015.
- Britto, M. R., and F. C. T. Lima.** 2003. *Corydoras tukano*, a new species of corydoradine catfish from the rio Tiquié, upper rio Negro basin, Brazil (Ostariophysi: Siluriformes: Callichthyidae). *Neotropical Ichthyology* 1:83–92.
- Britto, M. R., F. C. T. Lima, and M. H. Hidalgo.** 2007. *Corydoras ortegai*, a new species of corydoradine catfish from the lower Río Putumayo in Peru (Ostariophysi: Siluriformes: Callichthyidae). *Neotropical Ichthyology* 5:293–300.
- Castro, D.** 1987. The fresh-water fishes of the genus *Corydoras* from Colombia, including two new species (Pisces, Siluriformes, Callichthyidae). *Boletín Ecotropical* 16:23–57.
- Farris, J. S.** 1988. Hennig86, version 1.5. Program and documentation. Port Jefferson. <http://www.cladistics.org/education/hennig86.html>
- Ferraris, C. J., Jr.** 2007. Checklist of catfishes, recent and fossil (Osteichthyes: Siluriformes), and catalogue of siluriform primary types. *Zootaxa* 1418:1–300.
- Fuller, I. A. M.** 2001. Breeding Corydoradine Catfishes. Ian Fuller Enterprises, Worcestershire, U.K.
- Fuller, I. A. M., and H. G. Evers.** 2005. Identifying Corydoradinae catfish. *Aspidoras–Brochis–Corydoras–Scleromystax* and C-numbers. Ian Fuller Enterprises/A.C.S. GmbH (Aqualog), Worcestershire/Rodgau, U.K.
- Lundberg, J. G.** 1970. The evolutionary history of North American catfishes, family Ictaluridae. Unpubl. Ph.D. thesis, The University of Michigan, Ann Arbor, Michigan.
- Nijssen, H., and I. J. H. Isbrücker.** 1980. Three new *Corydoras* species from French Guiana and Brazil (Pisces, Siluriformes, Callichthyidae). *Netherlands Journal of Zoology* 30:494–503.
- Nijssen, H., and I. J. H. Isbrücker.** 1986. A review of the genus *Corydoras* from Peru and Ecuador (Pisces, Siluriformes, Callichthyidae). *Studies on Neotropical Fauna and Environment* 21:1–68.
- Reis, R. E.** 1997. Revision of the Neotropical genus *Hoplosternum* (Ostariophysi: Siluriformes: Callichthyidae) with the description of two new genera and three new species. *Ichthyological Exploration of Freshwaters* 7: 299–326.
- Reis, R. E.** 1998. Anatomy and phylogenetic analysis of the Neotropical callichthyid catfish (Ostariophysi, Siluriformes). *Zoological Journal of the Linnean Society* 124: 105–168.
- Reis, R. E.** 2003. Family Callichthyidae (armored catfishes), p. 291–309. *In: Check List of the Freshwater Fishes of South and Central America*. R. E. Reis, S. O. Kullander, and C. J. Ferraris, Jr. (eds.). EDIPUCRS, Porto Alegre, Brazil.
- Schaefer, S. A.** 1988. Homology and evolution of the opercular series in the loricioid catfishes (Pisces: Siluriformes). *Journal of Zoology* 214:81–93.
- Schaefer, S. A., and A. Aquino.** 2000. Postotic laterosensory canal and pterotic branch homology in catfishes. *Journal of Morphology* 246:212–227.
- Schaefer, S. A., S. H. Weitzman, and H. A. Britski.** 1989. Review of the Neotropical catfish genus *Scoloplax* (Pisces: Loricarioidea: Scoloplacidae) with comments on reductive characters in phylogenetic analysis. *Proceedings of the Academy of Natural Sciences of Philadelphia* 141:81–211.
- Taylor, R., and C. C. Van Dyke.** 1985. Revised procedures for staining and clearing small fishes and other vertebrates for bone and cartilage study. *Cybium* 9:107–119.